



Australian Government
Chief Scientist

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Saluting Roy Stanhope: teacher, leader, legend

When Vic Dobos asked me to deliver the Roy Stanhope Oration at CONASTA 65, of course I leapt at the chance.

The need for an organisation like the Australian Science Teachers Association is so obvious today that we forget just how far ahead of his time its founder really was.

We know of one research report on science teaching in schools published in this country prior to World War II. Just one.

Roy Stanhope wrote it.

But he wasn't the sort of researcher who rests content with publishing reports. He was the sort of visionary who acts on what he finds.

He founded ASTA, in 1943.

He led the ground-breaking national survey of secondary science teachers in 1964.

He pointed out that thirty per cent of the teachers who responded to that survey had no tertiary qualifications in science.

And that evidence really did hit the mark. It shifted the terms of the national debate, and helped to change the approach to teacher education.

For all those decades, Roy played the long game. He never gave up the mission. He let the data make the case.

So in the tradition of Roy Stanhope, I have come to CONASTA 65 with some data of my own: a national score-card on science and mathematics in secondary schools prepared by the staff in my office.

I'm proud to launch it tonight, and I will have more to say about its contents in a few moments' time. I hope, like Roy, we can use that evidence to good effect.

But first, I tip my hat to a skilled teacher of science and a wonderful servant of our country.

Taking flight with science

Now I have never seen a comprehensive list of the inspiring figures of history who were also great teachers of science – but I suspect it would be very long. I am always stumbling into science teachers in unexpected places!

Just the other week, I had reason to inquire into the history of the hot air balloon. And guess what – the first person to ever go up in a hot balloon was a teacher of chemistry and physics.

His name was Jean-François Pilâtre de Rozier, and he made the first manned, untethered hot air balloon flight in 1783.

At first I couldn't believe it. I've spoken to a lot of school principals over the years. And I can tell you, a qualified chemistry and physics teacher isn't easy to find.

You tie them down – you would never send them off in an experimental aircraft!

Even at the time, the French king was extremely reluctant to let this determined young man risk his life. He wanted to put two condemned criminals in the basket instead.

But de Rozier read it differently. He knew that this experiment was a risk – but he chose to redefine it as an opportunity. And in his eyes, that opportunity was a tremendous honour.

He put that case to the King, and he won. And so it was that when the first balloon rose into the sky, the first flying science teacher was on board.

Ladies and gentlemen, science teachers have been superheroes for a very long time.

Now I could go on to say that the first flying science teacher was also the first known fatality in an air crash, due to an unfortunate incident that took place in the following year. But why ruin a good story with an awkward sequel?

My backstory

Of course, that's the trouble with superheroes these days – the endless and appalling sequels. And when they're done with sequels, they have to have prequels, so they can ruin the story at both ends.

But I won't judge, because Vic has asked me to share a bit of my own prequel today – and I'm delighted to do so.

A long time ago, in a school far away... some great teachers turned me from a curious child to a soldered-on geek.

Mr Fergus, my senior chemistry teacher. Mr Noonan, my senior physics teacher. And Mrs Trend, my senior mathematics teacher and the Head of the school.

There were other teachers along the way, too – teachers who made science and mathematics a rich and wonderful part of growing up.

Today I look back at the science fiction stories and comic books of my childhood – and I still think they're fantastic.

Back then, we thought the things their authors imagined were too fantastic to ever be real. Today, we think the *authors* were fantastic – because so many of the things they wrote about have come to pass!

I don't need the special powers of a 1960s superhero today! With what science has given me, I can see through the planet with X-ray vision! Lift enormous weights with a super-strong exoskeleton! Run through a battlefield, with bullets bouncing off me!

So science makes superheroes look ordinary – or as I prefer to see it, ordinary people with science are superheroes.

I look at the possibilities of the world today. I cast my mind forward to the even *more* extraordinary possibilities of the world ahead. And I'm filled with excitement about the lives my grandchildren and their children might one day enjoy.

On the other hand – I'm terrified at the thought of a world divided between superheroes with science, and strugglers without it. And the difference I see between those two groups comes down, in large part, to education.

Of course, it's not *just* a question of education – it's about access to resources, attitudes in society and opportunities in the workplace as well.

But with education we have a shot of overcoming disadvantage – the best shot in life we're likely to get. And I see all too many indications that we are headed down the path to deeper division: a division that diminishes us all.

A national scorecard for secondary science and maths

The scorecard I am releasing today doesn't contain new data. It simply sets out the hard reality this audience confronts every day, focusing on science and mathematics in Australian secondary schools.

It is the baseline – from which we hope to see improvement.

In 2003, in the PISA tests run by the OECD, we ranked fifth in the world in maths, with a score of 524. In 2012, we ranked seventeenth, with a score of 504.

So we declined – judged against ourselves, and judged against the rest of the world.

The same is true in science, if not as stark.

In 2006, we ranked 4th in the world, with a PISA score of 527. In 2012, we ranked 8th, with a score of 521.

We could say “that's great – where's the problem in a fall of six points?”

I say it's a problem that our students are, at best, only *just* declining. I say it's a problem that any decline could ever be accepted as a decent result!

But probe into that decline, and the situation becomes even more concerning.

There is, on average, a two year achievement gap between our best and worst performing states in mathematics. There is a year and half gap between our best and worst performing states in science.

Do we think that children in the ACT are somehow born two years smarter? As much as I respect Canberrans – I don't believe that's true!

Then delve deeper to look at the divide between cities and regions.

Again, in mathematics, we see on average, a *two year advantage* for students in urban areas compared to students with regional postcodes. And again, in science, it's a year and a half.

But worst of all is the divide between students on what we call 'socioeconomic' grounds. In science and mathematics, the gap between students from high SES homes and low SES homes is the equivalent of two and a half years of education.

Thirty months or 10 terms in school.

That puts some context behind the curious report I encountered the other day.

In the TIMSS study, students who reported having more than 200 books in the home scored, on average, 101 points higher in science than those with fewer than 25 books in their homes. That's an achievement gap of close to three years.

It's a correlation – not causation. But it says a lot.

Friends, we have the good fortune to live in one of the most prosperous societies on the face of the planet.

Today, the average person born in Australia lives longer, and better, than the aristocrats of our grandparents' time.

And yet we are sliding down the global ranks as a country. And we are blowing out the opportunity gap at home.

What on Earth are we doing – and how is this allowed to go on?

So I'm fired with the passion to get Australian science and mathematics education right. And I don't mean by dragging down the children who are already thriving! I mean by lifting up *every* child as a superhero, with incredible opportunities that are just dancing at the edges of my imagination today.

In fact I want the schoolchildren of 2050 to look back at the way I live now, and laugh, because it's all so boring and backwards. And I have to point out – I drive a Tesla electric car!

It's pretty clear to me that achieving that dream comes down to two groups of people: teachers and parents.

It is enormously difficult for me to speak to parents directly. So for me, the most important people to reach are teachers.

I know I don't need to tell you about the importance of the subjects you teach – but I offer what I can to support you to teach them well. And I want to encourage you to be critical advocates for science, reaching out to the people we really need to persuade – the millions of Australian mums and dads.

The path to the target

Now when I see a big problem to solve, I tend to react like Clark Kent. Jump into the telephone box, strap on the cape, and *fly*. In my case, I head to the airport and get on an aeroplane.

In my first three months as Chief Scientist, I attended 174 meetings, delivered 24 keynote speeches and stumped up to 15 media interviews.

It was important to me to introduce myself, hear from people, and make my wholehearted commitment to this mission abundantly clear.

Since that time you could say I have gone back to the Crystal Palace – more formally known as the Fortress of Solitude – to develop the detailed plans. For the last four weeks, I have been working on a three year strategy for the Office of the Chief Scientist.

I'm glad to say that strategy is ready to hit the Science and Education Ministers' inboxes very soon. And I hope you won't mind acting as my focus group today.

I have built my vision on four pillars: education, research, innovation and outreach.

Education, let me reiterate, comes first.

In my mind I tend to divide it in three: a quality education is the sum total of the curriculum, the extra-curricular opportunities and the teaching.

I look at the curriculum – and I don't see any opportunities for me to intervene in a helpful way. I look at the extra-curricular opportunities – and I see enormous potential, as I'll discuss. And I look at teaching – and I see how vital it is for me to do whatever I can to empower you, the experts.

This is the Roy Stanhope Oration, so I will say it again: teaching is a profession. It demands a professional's skills. It is a title that some of the great men and women of history have been proud to hold.

You are national assets, and for me, critical allies.

So I wanted to use the remainder of my time today to outline not just some of my ideas, but my ethos and approach.

I've had a couple of decades in research, innovation strategy and science education to reflect on these themes. In that time, I've:

- Created the STELR program, through the Academy of Technology and Engineering...
- Started the Cosmos for Schools program, through the nation's finest science publication, now in the hands of the nation's finest editor, who is coincidentally my wife...
- And built an early career researcher training program for brain scientists.

And now I've squeezed all of that thinking and doing into four key messages. Let's fly!

Message Number One: Aim high, with aspiration.

Wherever I look at the education system, I see incentives to lower our expectations.

There are aspiration-lowering incentives for students.

Why study maths at the advanced level, if your ATAR will be higher if you stick with intermediate? Why study maths or a science at all, if you can get into your chosen university course without it, because there are no pre-requisites to get in the way?

Students ask these questions of career counsellors every day. As the system operates today, it makes sense for them to do so!

But when students and parents opt out, that gives school principals the incentive to opt out, too. Why pay for great programs that students don't want? And I can see that it must be very tempting for a teacher to try to hang on to students by making the lessons as easy as possible.

So we have three groups of people – students, principals and teachers – making rational decisions that perpetuate an entirely irrational system-wide decline!

There is nothing crueller to children than a culture of low expectations. It blinds our children to their own potential – and it blinds this country to the outcomes we could achieve if we moved the dial from 'lowest common denominator'.

So one of my key initiatives over the next three years will be to shift the dial.

We need to build in reasons for schools to reach for excellence – and recognition for those schools that achieve results.

In my mind and in my strategy plan, I am beginning to envisage an aspirational awards program for schools, to encourage and reward their progress in maths and science education.

My interest is in progress, not school rankings or league tables. I don't want to reward schools for excelling today – although I certainly want to learn from those schools about how it's done.

I want to see recognition for *all* schools that commit to getting better, regardless of the position from which they start.

So, Message Number One: Aspire to great heights and work to empower those who do.

Which brings me to Message Number Two: think smart, with realism.

There are many people in the world today who think they have the answer to all the problems in education.

We could have humanoid robots teaching the lessons! We could require students to wear brain-boosting electric stimulators on their heads! At the other extreme, we could start every lesson with fifteen minutes of colouring in and singing!

I think we can respectfully, but firmly, park those ideas to the side.

Then there are other people, who do have insight and expertise, and genuinely well-informed ideas for education. We need those people.

But how often do we decide to pursue something new, without looking about to see what's already being done? How often do we miss the opportunity to scale up a pilot program, with a model actually proven to work? How often do we rush an idea from drawing board to delivery, without testing it first?

I suspect the answer is “all too often” – and the outcome is the plethora of extra- and co-curricular programs we see today.

Of course, it is a good thing when teachers have a broad range of tools – by which I mean high-quality, stress-tested tools. It is also a good thing when teachers can adapt good programs to the local context.

It is *not* a good thing to sprinkle resources across programs that schools can't access, implement or sustain when the funding ends.

As Chief Scientist, I have a tremendous advantage. I can look across the system, and think like an engineer.

I don't need to reinvent the wheel – or rebuild a segment of the wheel that already functions pretty well. I just need to work out how I can help to optimise the wheel's performance.

In particular, I can help to make connections.

This year we released the book that Vic Dobos has helped me to distribute here – the STEM Program Index, or SPI Guide. It is a catalogue of education programs offered by companies, universities, philanthropic groups and others, to complement the core work that teachers do in schools.

It's good – but it's limited. From the moment we hit print, it was out of date. From the moment we sent it out, we started hearing it was incomplete.

So we don't want a second edition book – we want the equivalent of a TripAdvisor portal. A powerful online repository that is easy to access, easy to search – in fine-grain detail – and easy to post reviews.

We're working on it, as part of the strategy... and I'll have more to say in the next few months.

And so to Message Number Three: lead from the top, with conviction.

I've tried to achieve many hard things over the years – some with more success than others. I've learned that it's not enough to have a good idea and a personal commitment. It simply doesn't work unless you can persuade others to come along.

This is particularly true when it comes to the education of our children.

There is nothing more precious to parents than their children. There is no greater anxiety than the fear that we're missing the chance to get their future right! As a parent, I know that anxiety and sense of obligation.

I also know that teachers commit to this profession because they care very deeply. They certainly don't do it for the pay.

So I don't have to persuade the important people to care. I do have to persuade people that the goal is achievable, and the path is sound. I also have to show that I'm prepared to gather the evidence, learn from the experts and be held to account.

This evening I have declared to you my strategic intent for two new programs. And the judges of those programs will be the people in this room.

So CONASTA 2018 – book me in! And until we get there, I'm looking to you to keep me up to the mark.

And finally Message Number Four: don't forget Message Number One. *Aspiration.*

I know that progress in this mission can seem at times to be painfully slow. The impacts may not be felt for many years, and all the inconvenience and grief is carried today.

But that's science – reaching today for something hiding in the future. We're in the wrong room if we plan to waste our time on something easy. As Roy Stanhope's torch-bearers, we must not give up because the going gets hard.

It's right there in the conference brochure – you're superheroes. A genuine league of superheroes. And it's written into the script that the superhero always wins. And so can we.

I promise my utmost resolve for the next three years. I welcome your companionship and advice. And let me leave you with a challenge for the year ahead, because superheroes without a challenge are just people running round in capes.

Help me to act on the strategic intentions I've declared today. Help me to get these programs right – and help me to explain them in ways that principals and parents can understand.

Remember, the vision is a nation that leaps tall buildings. The starting point is a nation in the elevator, heading down.

And up there in the sky... it's not a bird... it's not a plane... it's a *science teacher*.

Let's get out there and save the day. **THANK YOU**